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REMARKS

Status of the Claims

Claims 1-15 were examined and remain in the application. Claim 1 is amended. Reconsideration of the claims is requested for the very pertinent reasons set out below. The amendment to claim 1 is not new matter, as it is taken from page 3, lines 19 to 21 of the published priority document WO 2005/031250.

Summary of the Rejections

The Examiner has rejected claims 1 to 5, 7, 8, 10, 14 and 15 as lacking novelty under Section 102(b) over US 5,760,593 (Lawrence et al.).

Claims 6, 9, 11 to 13 have been treated as obvious over the combination of US 5,760,593 (Lawrence et al.) and US 5,973,502 (Bailleul et al.).

Applicant directs comments primarily to claim 1 on the basis that, because this claim recites a combination of features which is both new and non-obvious, being unanticipated by Lawrence et al.

Claims 2-15 are believed also to be allowable for same reasons as directly or indirectly dependent from claim 1.

Novel and Unobvious Features of Claim 1

As Examiner will upon review again appreciate, claim 1, now further amended by additionally providing the clause "such that the sensor assembly remains virtually stress

PAGE 7/16 * RCVD AT 7/25/2007 5:28:33 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-6/20 * DNIS:2738300 * CSID:314 345 4704 * DURATION (mm-ss):03-46

free at high operating temperatures," is directed to a sensor for capacitively measuring the distance to a stationary or passing object. The sensor includes an electrode for coupling with the object, an insulating layer, a shield and a housing. The electrode and the shield are conductive components and are formed entirely from an electrically conductive ceramic material. The insulating layer and housing are insulating components and are formed entirely from an electrically non-conductive ceramic material. The final limitation is that the electrically conductive and electrically non-conductive ceramic materials are selected to have substantially similar thermal expansion coefficients. In addition, the claim recites the additional characteristic by the clause, "such that the sensor assembly remains virtually stress free at high operating temperatures."

Referring to Paragraph 2 of the Office action, we believe that Examiner's description of the sensor of Lawrence et al. is just plain wrong. We respectfully submit that Examiner should reconsider. The sensor of Lawrence et al. includes an electrode 4 that can be made of metal (column 3, lines 4 to 8), a non-conductive ceramic material that is rendered conductive by having a layer of conductive material (i.e. a metal) deposited on its surface, or a conductive ceramic/metal composite (column 3, lines 8 to 15). A shield is electrically isolated from the electrode by an insulating layer. However, contrary to the opinion of the Examiner, there is nothing in Lawrence et al. to suggest that the shield can be made of anything other than metal.

Turning first to the embodiments illustrated with reference to Figs. 1 to 4 of Lawrence et al., it is clear that the shield of Fig. 1 includes a bottom guard 8 and top guard 10. These are the reference numeral used by the Examiner in paragraph 2 of the Office action However, column 5, lines 5 to 7 says that the "*electrode 4 is located within a shield with [sic] comprises a bottom guard 8 and a top guard 10, each of which* [like the electrode 4] *is also machined from steel.*"

In the embodiment of Lawrence et al. Fig. 2 the shield is deposited on the ceramic insulating layer 14. More particularly column 6, lines 5 and 6 say: "... *followed by a 0.3 mm thick layer 16 of platinum/iridium (excluding the front face) which forms the shield, and finally...*" The platinum/iridium layer is clearly not an electrically conductive ceramic. In the embodiment of Lawrence et al. Fig. 3 the electrode 4 is formed from bulk ceramic on which a platinum/iridium layer has been deposited by plasma deposition to form an electrically conductive layer. The insulating layers 14 and 18 and the shield 16 "*are formed on the electrode 4 as described above with reference to Fig. 2*" (column 6, lines 18 to 20). In other words, the shield 16 of Lawrence et al. Fig. 3 is also made of metal. The description relating to the embodiment of Lawrence et al. Fig. 4 makes no mention of the shield at all.

Moving back to the more general disclosure of the invention in the Summary of the Invention, column 2, lines 5 to 7 of Lawrence et al. explains how the shield and the insulating layer can be formed by deposition. The shield

PAGE 9/16 * RCVD AT 7/25/2007 5:28:33 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-6/20 * DNIS:2738300 * CSID:314 345 4704 * DURATION (mm-ss):03-46

can also be formed as a preformed part, in which case the insulating layers between the shield and the electrode and the shield and the casing may be deposited on the inner and outer surfaces of the shield (column 2, lines 22 to 25). The resulting probe is therefore formed by machining the electrode, the shield and the body from metal and depositing the insulating layers. This removes the need to form the insulating layers from rings of ceramic material, which is difficult to machine (column 2, lines 8 to 12). If the insulating layer is deposited directly on the electrode then the shield may, in turn, be deposited on the insulating layer.

It is of extreme importance that Examiner should appreciate that the deposited shield layers of Lawrence et al. are formed by one or more layers of metal, whereas the deposited insulating layers are formed by one or more deposited layers of electrically non-conducting ceramic material. In other words, the mere fact that shield layers can also be deposited does not imply, and certainly does not suggest, to the skilled artisan that these layers are also formed from an electrically conductive ceramic material.

In a preferred embodiment of Lawrence et al. the insulating layers and the shield are deposited such that the sensor is "*formed as a single, monolithic, item*" (column 2, lines 42 and 43). The Lawrence et al. patent explains that this particular structure has certain technical advantages. More particularly, the sensor will not be subject to differential thermal expansion of its component parts during operation. The claimed construction

PAGE 10/16 * RCVD AT 7/25/2007 5:28:33 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-6/20 * DNIS:2738300 * CSID:314 345 4704 * DURATION (mm-ss):03-46

provides the advantageous characteristic feature that the sensor assembly remains virtually stress free at high operating temperatures.

Examiner can appreciate that one of the characteristic problems with conventional known sensors of this type is that the differential thermal expansion of the metal and ceramic parts can cause them to become loose when the sensor is used at high operating temperatures. In the construction of Lawrence et al. this problem is addressed in two ways (see Lawrence et al. column 2, line 47 to column 3, line 1). First, most of the sensor is formed from the same material (this is especially true if the electrode is made of a non-conductive ceramic or a conductive ceramic/metal composite) so that the differential thermal expansion between the metal shield and the ceramic insulating layers is kept to a minimum. Secondly, the metal shield is formed by deposition of metal layers (platinum/iridium, for example) so that it is actually bonded to the adjacent ceramic layers and is less likely to become loose.

The present Applicant has discovered that the sensor of the type described in Lawrence et al. still suffers from the problem of differential thermal expansion. Although the differential thermal expansion is much less than that found in conventional sensors, which contain bulk metal parts and have machined or preformed ceramic rings of insulating material, such differential thermal expansion can still cause the deposited shield layers to delaminate from the adjacent ceramic layers. This delamination allows

PAGE 11/16 * RCVD AT 7/25/2007 5:28:33 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-6/20 * DNIS:2738300 * CSID:314 345 4704 * DURATION (mm-ss):03-46

the shield to vibrate during use and can eventually result in the mechanical failure of the complete sensor assembly.

The sensor of the presently claimed invention, as set forth in claim 1, overcomes these problems in a completely new way, namely by eliminating all metal parts (not just bulk metal parts) so that the sensor is formed entirely of ceramic materials. Moreover, the electrically conductive and non-conductive ceramic materials are selected to have substantially similar thermal expansion coefficients so that the sensor remains virtually stress free at high operating temperatures, as emphasized in the above-referenced additional limitation in claim 1.

Upon reconsideration, far greater care must be taken to assess what teaching the skilled artisan who is a reader of Lawrence et al. would receive from the document as a whole, and not just from a few isolated paragraphs. Applicant believes that the present invention is fairly and substantively inventive over Lawrence et al., being neither anticipated nor obvious thereover, for the following reasons.

Lawrence et al. suggests that it can be advantageous to form a sensor that does not employ bulk metal parts. However, this is not sufficient motivation in itself for the skilled person to eliminate the metal parts completely. In practice, the elimination of all metal parts is not obvious over the reference because Lawrence et al. describes a sensor having a deposited metal shield that can be used in high operating temperatures of 1200°C or above (column 3, lines 17 to 20). Put another way, if the

skilled artisan knows that the sensor can be used at high operating temperatures simply by replacing the metal electrode with one that is made of a non-conductive ceramic material or a conductive ceramic/metal composite, then why would it be obvious to further modify the sensor by replacing all of the metal parts with corresponding parts made of an electrically conductive ceramic material? Such a modification is not necessary to make the sensor technically suitable for its intended operation.

Applicant insists that Lawrence et al. teaches against such a modification by providing a different (and on the face of it, an effective) solution to the problem of differential thermal expansion.

The claimed feature of matching the thermal expansion coefficients of the conductive and non-conductive ceramic materials (as recited, "the electrically conductive and electrically non-conductive ceramic materials are selected to have substantially similar thermal expansion coefficients") is both novel and inventive over the teaching of Lawrence et al., because this feature is fundamentally contrary to the disclosure of Lawrence et al. where the metal parts such as the shield and the metal coating applied to the non-conductive ceramic electrode are retained in the sensor. When the Lawrence et al. disclosure is considered as a whole, the skilled person is effectively told to accept that there will be some differential thermal expansion but that this can be minimized to levels where it will not cause any practical problems because of the lack of bulk metal parts. The skilled artisan would understand readily that the thermal

PAGE 13/16 * RCVD AT 7/25/2007 5:28:33 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-6/20 * DNIS:2738300 * CSID:314 345 4704 * DURATION (mm-ss):03-46

properties of the metal and ceramic material that are used in the sensor of Lawrence et al. do not even come close to being matched. By way of example only, the average thermal expansion coefficient of platinum/iridium (i.e. a deposited metal layer) is 8.7×10^{-6} K^{-1}, whereas the average thermal expansion of aluminum nitride (i.e., a deposited insulating layer) is 4.5×10^{-6} K^{-1}.

Therefore, even if the skilled person did look to modify the sensor of Lawrence et al. to replace all the metal parts, it is not obvious to substantially match the thermal expansion coefficients of the conductive and non-conductive ceramic materials to arrive at a sensor that falls within the scope of claim 1. That is not to say, however, that the matching of the thermal expansion coefficients is just a natural consequence of the use of ceramic material throughout the sensor. There are many different types of electrical conductive and non-conductive ceramic materials that would be suitable for use in the sensor. It is therefore not just a simple task of selecting conductive and non-conductive ceramic materials at random and assuming that their respective thermal expansion coefficients will be substantially similar. However, once a proper selection is made then the sensor of the present invention has a much longer operating time and can be used at higher temperatures than conventional sensors in that the sensor assembly remains virtually stress free at high operating temperatures. In paragraph 2 of the Office action the Examiner seems to suggest that a disclosure for matching the thermal expansion coefficients can be found at column 3, lines 25 to 61 of Lawrence et al.

But that is not so. This paragraph of Lawrence et al. relates to the various methods that are available for deposition (i.e. deposition in the condensed phase or vacuum, chemical and plasma deposition) and the options for having one or more layers. Insulating layers are generally oxides and nitrides of metals of metalloids such as oxides and nitrides of aluminum, titanium, tantalum and silicon. There is nothing here in Lawrence et al. to suggest the improvement of choosing the composition of the insulating and shield layers to have substantially similar thermal expansion coefficients.

In view of these precise points, Examiner is asked to reconsider claim 1, as amended, in light of the Lawrence et al. reference, for it sets forth a combination which Lawrence et al. has neither taught nor suggested. Claim 1 is not anticipated by Lawrence et al. and is patentably unobvious thereover.

Claim 1 should accordingly be held allowable.

Claims 2-15 are believed also be allowable for same reasons as being dependent from claim 1 either directly or indirectly.

It is again noted that claims 6, 9, 11 to 13 have been rejected as being obvious, according to Examiner, over the combination of US 5,760,593 (Lawrence et al.) and US 5,973,502 (Bailleul et al.). Bailleul et al. has been reviewed but is not believed to remedy the deficiency of Lawrence et al., which for the reasons detailed above, has

failed to anticipate or render obvious the combination set forth in claim 1.

Accordingly, very careful reconsideration of claims is warranted and is requested.

It is believed that the foregoing resolves all remaining issues, and the application is in good order for allowance, and a Notice of Allowance is solicited. The undersigned looks forward to working with Examiner to resolve any remaining issues in the application. If Examiner has any questions or believes there is any remaining issue, which could be readily resolved or other action could be taken to advance this application, such as by Examiner's amendment or interview by telephone or in person, it is requested that Examiner please telephone or e-mail the undersigned representative to arrange telephone interview, and the undersigned will gladly cooperate to advance the prosecution.

Respectfully submitted,

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Date

Peter S. Gilster, Reg. 25,337
Greensfelder, Hemker & Gale, PC
10 S. Broadway, Suite 2000
St. Louis, Missouri 63102
314-345-4741 Direct Tel.
314-241-9090 General Tel.
314-345-4704 Direct Fax
E-MAIL: psg@greensfelder.com
Attorneys for Applicant
Customer Number: 22807

PSG:KMB